DATACOMPUTER SUPPORT OF SEISMIC DATA ACTIVITY

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1. Overview

1.1 Project Goals

The purpose of the project is to support the ARPA-NMRO Seismic Data Activity by providing data storage and retrieval services. The Arpanet will be used as the communication channel. As part of the service, seismic data will be (a) collected form the Arpanet; (b) stored; and (c) made available to computers on the Arpanet in a convenient and timely manner. These services represent a special application of the Arpanet Datacomputer being implemented by CCA under Contract No. MDA903-74-C-0225.

The amount of data to be kept on-line necessitates the addition of a mass memory to the data computer system. An Ampex Terabit Memory System (TBM) with a capacity of almost two hundred billion bits has been contracted for and will be installed at CCA later in the year. Also needed for this project is a small Seismic Input Processor (SIP). The SIP will collect data over the network on a round-the-clock basis. It will reformat the data and buffer it. At regular intervals, the SIP will generate a datalanguage update request and burst the data to the Datacomputer via the CCA TIP (see Fig. 1).

1.2 Status of the Project

The activity on the project is divided into three areas: acquisition and integration of the TBM System into the Datacomputer; SIP development; and coordination with the seismic community.

The TBM Memory System is being built by Ampex Corporation as a subcontractor to CCA. The initial TBM configuration will be one transport driver, two dual transport modules, one data channel and a Communications and Control System (CCS).

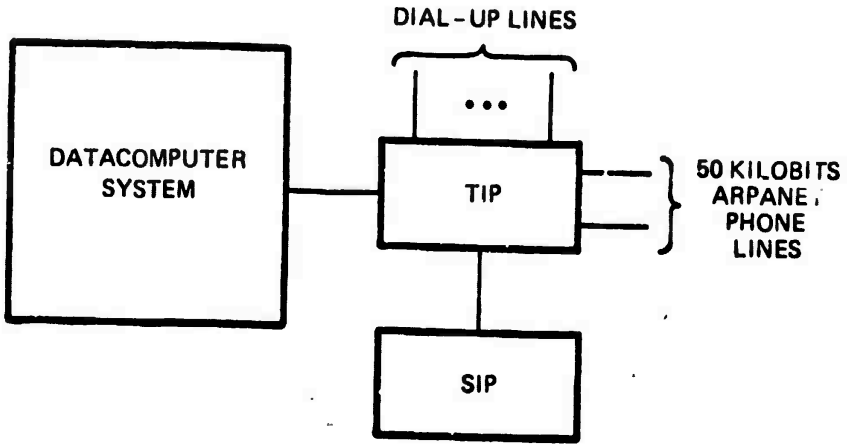

Figure 1 - CCA Installation

The components are currently undergoing fabrication and stand-alone testing. The complete TBM memory system is scheduled to be delivered to CCA in August 1975 and to be accepted in September 1975.

The SIP hardware consists of a DEC PDP-11/40 with 28K core, two RP04 disks with a storage capacity of 176 million bytes, and an Arpanet interface. Installation of the PLP-11 and peripherals has been completed, and SIP software development has begun. The TIP modifications required to interface the SIP to the Arpanet have been delayed by the Government and by Bolt Beranek and Newman Inc. until June 1975.

CCA has met with BBN and VSC to review the CCP-SIP protocol specifications. This is a special-purpose protocol that will allow for faster transmission of real-time data than the standard host-host protocol. As a result of the last meeting, several modifications were adopted.

CCA continues to work closely with the seismic community to determine requirements for data storage and retrieval services. Efforts are still under way to specify suitable file formats for storage of the seismic data. These formats reflect the way in which the data is collected, the way in which it will be used, and the most efficient ways of using the Data-computer hardware and software.

During the current reporting period, CCA participated in a meeting at SDAC to discuss the seismic data file formats. The meeting focused on the best organization for the Preliminary Event Summary File and the Preliminary Signal Waveform File, on the datalanguage description of the array channel data, and on the handling of off-line data. As a result of the meeting, SDAC will revise the memorandum on file formats.

In order to gain operational experience with seismic data, several sample seismic databases, corresponding to different file formats, have been loaded onto the Datacomputer. The user program SMART has been modified to access data corresponding to the Preliminary Event Summary File. SMART will be used with this database for purpose of demonstration, testing and measurement.

2. TBM

In order to satisfy the requirement for a large on-line database, an Ampex Terabit Memory System (TBM) is being installed at CCA as a part of the Datacomputer. The TBM consists of two parts: a Data Storage Section (DSS), which is the repository of all data stored within the TBM; and a Communications and Control System (CSS), which provides message and data interfaces between the PDP-10 and the TBM.

2.1 Hardware

The DSS of the TBM consists of one transpost driver, two dual transport modules, and one data channel. The initial hardware increment of one transport driver, one transport module and one data channel is currently undergoing stand-alone testing. Final assembly of the second transport module is under way.

The CCS consists of a System Control processor, a Transport Driver Interface Unit (TDIF) and a Channel Interface Unit (CIU). The TDIF is undergoing final assembly and testing. Upon test completion, the TDIF will be integrated into the system as the primary interface unit between the transport driver of the DSS and the PDP-11/35 of the CCS.

2.2 Software Specifications

Ampex has submitted TBM software interface specifications to CCA for approval. These specifications describe the external characteristics of the TBM. More specifically, they describe the interface between the PDP-10 and the TBM via the CIU, and they describe the interface between the TBM system and an operator.

Technical discussions regarding the specifications are underway between CCA and Ampex. The specifications do not allow for transfer of data from the tally track on TBM tape to the PDP-10. We are currently investigating the feasibility of allowing for such transfers.

2.3 Site Preparation

Enhancements to the CCA computer installation are necessary in order to accomodate the TBM memory system and the SIP. The requirements for space, electricity, water, cooling, false flooring, and the like have been determined. Contractors have submitted bids for the site work needed to meet these requirements.

3. SIP

Seismic data will be collected from the Arpanet and buffered by a small Seismic Input Processor (SIP) before retransmission to the Datacomputer. The SIP has two 3330-type spindles, which allow for 24-hour buffering of a 15 kilobit per second data stream.

The SIP is a host on CCA's TIP. The SIP communicates with the Datacomputer as any other host would, that is, using data-language, network data connections, and the standard Arpanet host-host protocol. Transfer rates are expected to be much higher than normal network communication, however, since no phone lines are involved.

During the current reporting period, CCA performed measurements on the data rate through the CCA TIP. The observed rate was in the range of 50-80 kilobits per second instead of the expected 300 kilobits per second. This discrepancy was reported to BBN and to ARPA. BBN is expected to take corrective action, though as yet there is no estimate of when that will happen.

The SIP communicates with the CCP at SDAC using a data transfer protocol which is specially developed for this purpose. This protocol will be more efficient for real-time data than the standard Arpanet host-host protocol. CCA continues to coordinate with VSC and BBN in specifying the CCP-SIP protocol. In the latest revision of the protocol, the "hello/I-heard-you" handshaking was deleted, since the information would be redundant. In addition, the file definition messages were broken up into structural check messages and status messages. This allows for the handling of all status information in the same fashion. The protocol change will be reflected in the format of the status files to be stored on the Datacomputer.

The SIP hardware was installed during the previous reporting period. This includes the PDP-11 with 28K core and two RP04 disks. During the current reporting period, DEC delivered the Arpanet interface. The hardware has been checked out, and difficulties with the disks have been identified and fixed.

The Distant Host Interface, to be provided by BBN, still has not been installed in CCA TIP. As a result, the SIP is still not a host on the Arpanet. As a temporary measure, the SIP has been connected to the CCA TIP as a terminal instead of as a host. This allows for transfers between the PDP-11 and the PDP-10, which are required for SIP software development. Debugging packages and a loader, both needed for programming the SIP, have been loaded onto the PDP-11 and are operational.

4. Coordination with the Seismic Community

The amount of seismic data to be cclllected necessitates that the data be handled as efficiently as possible if the application is to be feasible. Design of the application requires a thorough understanding of how the data is to be collected and how it is to be used. Towards this end, CCA continues to work closely with VSC,SDAC,BBN and others to identify the data storage and retrieval requirements for the seismic application.

CCA has obtained seismic data from Lincoln Laboratories and loaded it into a Datacomputer file. The data consists of 114,000 records and corresponds to the data in the Preliminary Event Summary File. Lincoln Laboratories will use SMART, a CCA-provided user program, to access the data and to perform measurements. The operational experience will help to determine which parameters should be inverted and whether there are unexpected inefficiencies in the file formats.

As a result of a meeting between CCA and SDAC, the file formats were modified. In the raw data files, the TIMESERIES list was modified to allow a user to access only the data from the channels of interest to him; previously, data from all channels had to be retrieved together. In addition, the status information to be stored for each site will be based on what is actually available for the site. While this decision sacrifices the uniformity of the data descriptions, it results in considerable savings in storage space.

The organizations of the Preliminary Event Summary File and the Preliminary Signal Waveform File were reviewed in detail. Minor adjustments in the way the former points to the latter were made. A decision regarding which parameters to invert awaits operational experience with the data. Though the choice of inverted parameters critically affects the performance, it does not affect the development of system as a whole and therefore can be advantageously postponed.

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